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BLAWFORMS *FOR* GENERAL CONCRETE CONSTRUCTION



Concrete forms

BLAW-KNOX COMPANY
PITTSBURGH, PA.

FORMS
OF
CONCRETE
CONSTRUCTION



OX COMPANY
URGH, PA.

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Blawforms for General Concrete Construction



All Blaw-Knox Forms Fully Covered by Patents
or Patents Pending

Catalog No. 23

Blaw-Knox Company

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FOREWORD

THERE are Blaw-Knox Forms for every variety of concrete construction. We are able to make this broad statement because for a period of years some of the most capable engineers in the country have centered their training and experience in the production of Blaw-Knox Forms to meet conditions in construction which have arisen and multiplied with the increase in the nation's industry and population.

We are endeavoring in this book to describe various classifications of Blaw-Knox Steel Forms and their uses, illustrating the text with appropriate photo-engravings. Necessarily the descriptions are terse and do not adequately cover all variations of the types of forms manufactured to meet other conditions.

Every contract in which concrete is used is an individual form proposition with us, and each job is handled in exactly the way which is justified by the method of doing the work, the size of the contract, and the aim of the contractor or engineer.

It is felt that the contact which our engineering department has with absolutely every concrete job which is let, their opportunities for studying methods of doing the work and ways of planting the job, and in fact their intimate knowledge of every phase of construction work, are of such value that their advice and suggestions should be welcome to the majority of engineers and contractors.

We therefore offer the services of our engineering department to engineers and contractors, without restrictions or obligations and it will be a pleasure to have you use this service as you see fit. We work with the engineer from the time the form job is conceived, through the actual writing of the specifications. We cooperate with the engineer and contractor from the time the job is advertised until it is entirely completed. This is one form of Blaw-Knox service.

In developing the steel form as an aid to concrete construction, we have found that there are certain fundamental values in them that engineers and contractors should take into consideration when designing work or applying forms to the construction. In general, these points are as follows:

Steel forms can be removed in very much less time than wood forms after the concrete has been placed, due to the facts that all Blawforms



are collapsed mechanically without injuring the concrete and that concrete does not adhere to steel as it does to wood.

Blaw-Knox Steel Forms present a highly finished surface to the concrete, insuring a finish to the completed work that is perfectly smooth. This helps to reduce friction and also prevents erosion of the structure itself.

The use of reinforcing steel in the construction again proves the value of Blawforms as there is no wear and tear on the forms resulting from the placing of reinforcing rods as is the case where wood forms are used. This provides an additional saving in time and money.

All the engineering on the form is worked out long before the actual work is begun, and therefore nothing is necessary on the job except to erect the forms and use them.

Blawforms are mechanically operated. They can be collapsed or telescoped to travel through forms already concreted, reducing handling costs and speeding up the work.

All Blawforms materially reduce labor costs as compared to wood forms.

No matter when or where you build, it will pay you to ascertain what savings Blawforms can make for you. We will gladly submit designs or estimates on steel forms for any concrete work you may have under consideration.

All Blaw-Knox Steel Forms are thoroughly covered by patents or patents pending.



*Blawforms for General
Concrete Construction*

Half-round Sewer Forms

HALF-ROUND Blawforms have been used for over fifteen years in all parts of the world. Every instance of their use has proved, without exception, that they enormously reduce the cost of concrete work, shorten the time for completion of the work and produce better results than can possibly be obtained with wood forms.

These forms consist primarily of steel crowns and inverts of the same diameter, design and strength. The forms are flexible and they are fitted with turnbuckles as part of the standard equipment. After the concrete has set sufficiently, the turnbuckles are released and the forms collapsed to a degree sufficient to insure their ready removal without disturbing the green concrete.

Half-round Blawforms are designed to meet the requirements of the engineer where conditions are such that the construction of the conduit can be effected in two or more operations; that is, where it is deemed best to place the invert of the conduit first and the crown later, having a construction joint at the horizontal springline. It has been found, moreover, that the costs of the work when this type construction is followed are very much lower not only on the actual construction, but also on the form work itself.

As both crown and invert forms are identical they provide for the interchangeability of the forms as the work progresses. Because of the fact that in most places and under ordinary conditions it is permissible to remove the invert forms in a shorter time than the crown forms, after the concrete has been placed, contractors usually use only half as many forms for the invert as are used for the crown. Thus if a uniform progress of 50 feet per day is to be maintained, there would be required only 75 lineal feet of Half-round Blawforms of which 50 feet would be used for the crown and 25 feet for the invert, the invert forms being moved twice to every move of the crown.

To handle the crown forms, wood struts are laid across the completed invert at various





Blaw-Knox 48-inch Half-round Steel Form. Used all over the United States.
Note method of arranging supports and boards for moving the forms ahead in
any length desired.

The foreground shows invert already concreted and the forms moved ahead.

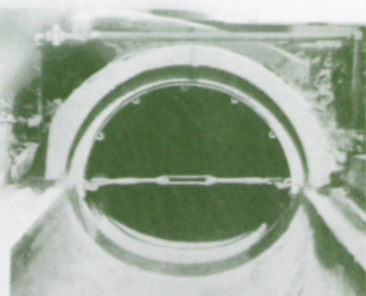


*Blawforms for General
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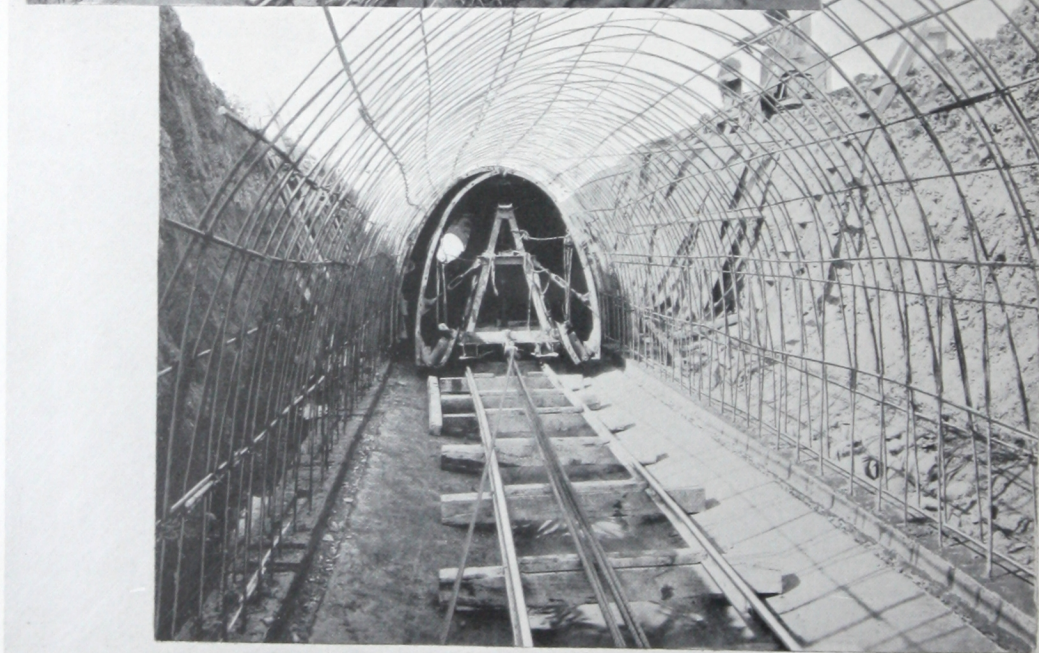
intervals and a plank is placed longitudinally on top of these struts. These planks act as tracks on which to roll the form. It is thus evident that the crown forms can be moved ahead in train, 50, 75 or 100 feet of forms at one time. The cross collapsing turn-buckles are provided with rollers or wheels which render such movement very easy and it is evident that the movement of a large number of these forms in the manner described will result in a great saving of time and labor. For example, it has been found that in many instances, 100 lineal feet of crown forms have been collapsed, rolled ahead and set up again ready for concreting in one and one-half hours.

The method pursued in handling invert forms is very similar except that as no track can be provided it is necessary to skid the forms to their new positions after collapsing them. This movement is, however, simplified owing to the fact that the sections can be handled in train the same as the crown forms.

It is readily apparent from the foregoing description of Half-round Blawforms and their uses that every point in their comparison with wood forms results in showing a decided saving in money, time and much more favorable results as a whole when the steel form is used.



*Blaw-Knox for General
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Blaw-Knox Telescopic Horseshoe-shaped Sewer Forms used by the city of Flint, Michigan. Note in upper illustration the forms have been moved out of the completed work around a sharp curve. In lower illustration the forms have been collapsed and are being moved forward through forms that are being concreted.



*Blawforms for General
Concrete Construction*

Egg-shaped and Horseshoe Blawforms

MANY engineers specify the egg-shaped sewer as being more nearly adequate to the solution of a particular problem than the circular form of conduit. To meet these specifications there are Blaw-Knox Steel Forms of any desired size.

In the construction of the egg-shaped sewer, a method of procedure similar to that described in the preceding section is followed, in that the invert is placed first and the crown concreted afterwards. Blawforms for egg-shaped construction are designed and handled in the same manner as half-round forms and include a semi-circular form for the crown and a special egg-shaped form for the invert, both of steel.

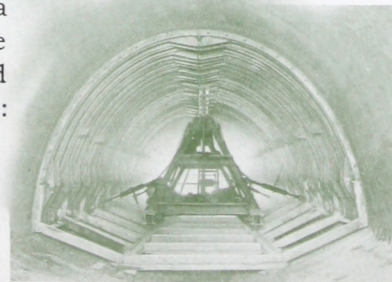
In many instances however, local conditions preclude the use of either the circular or egg-shaped sewer or conduit and engineers specify a horseshoe or elliptical form of construction. There are many variations of these conduits each designed for some particular requirement, but they all can be divided into two classes; i. e., those with a half-round top and those with a semi-elliptical top or crown. Blawforms are made to suit all requirements however varied they may be, regardless as to whether such variation comes from the actual shape of the conduit or from the methods used in construction.

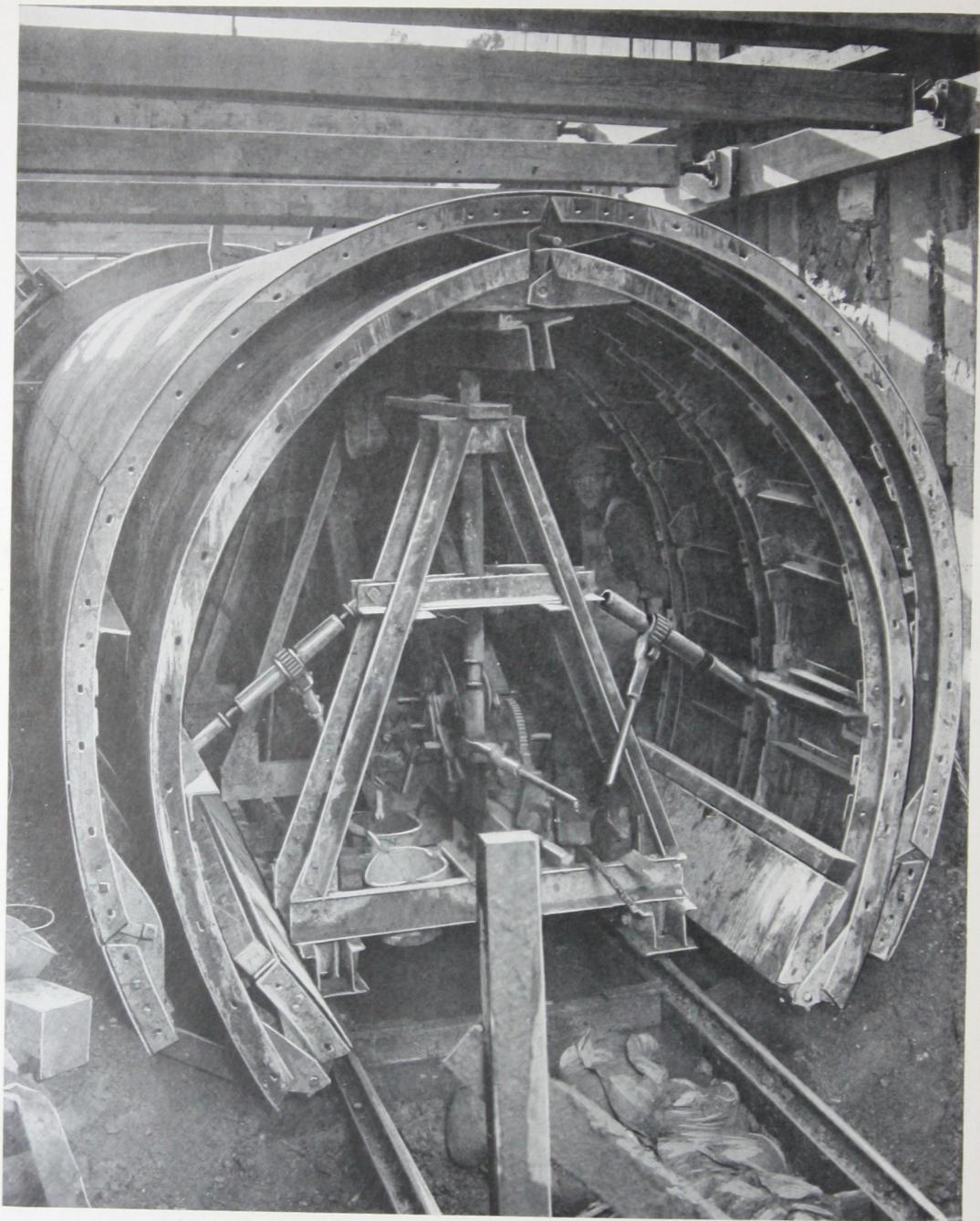
The Blaw-Knox system of handling contracts embodying special requirements is the most economical and satisfactory to all concerned. To this end a consultation is held by our specialists with the engineers or contractors responsible for the work, the correct methods to be followed are determined, and forms are designed to suit the requirements.

The methods pursued in the construction of these types of conduits may be divided into two classes:

1. Continuous pouring requiring a telescopic form.
2. Alternate block method requiring a non-telescopic form.

Telescopic forms are used when the character of the material to be excavated is such that it is necessary to keep a minimum amount of trench open ahead. The Blawform for this work is especially designed subject to the following standard specifications:





Blaw-Knox Telescopic Form for concrete sewers. The bottom quarter is cast first and the upper three-quarters last. Note forms collapsed and being carried forward on travelers.



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The forms are made in 5-foot sections bolted together endwise, thus making up working units of any required length. The shell plate next to the concrete is sufficiently heavy and amply reinforced with stiffeners of suitable strength and proper spacing to give great rigidity to the form. All rivets in the face are countersunk and ground smooth to insure an absolutely smooth finish to the concrete.

The form is usually divided into four pieces around the circumference, one joint being at the vertical centerline and the other two joints at or near the horizontal springline. At each of these joints, hinges placed horizontally are provided for collapsing the forms. All vertical and horizontal joints are bolted together.

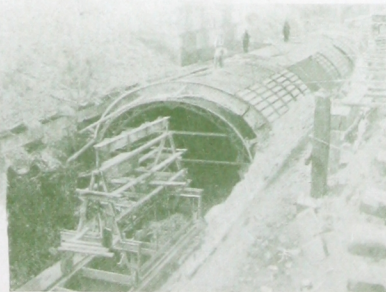
A traveler is furnished for handling the form. The length of this traveler is usually determined by the length of the conduit to be poured in one day. For instance, if the contractor wishes to pour 30 feet per day the traveler is designed to carry 30 feet of forms at one time. Flanged wheels are provided on all travelers to facilitate motion on steel rails. Vertical and horizontal jacks are provided for collapsing, lining up, etc.

The number of inside forms required depends upon the progress per day and the length of time the forms must remain in place before they can be moved. Thus if 30 feet per day is the required speed and two days are allowed for the concrete to set, 90 feet of forms and 30 feet of traveler are furnished. The following method of operation is pursued:

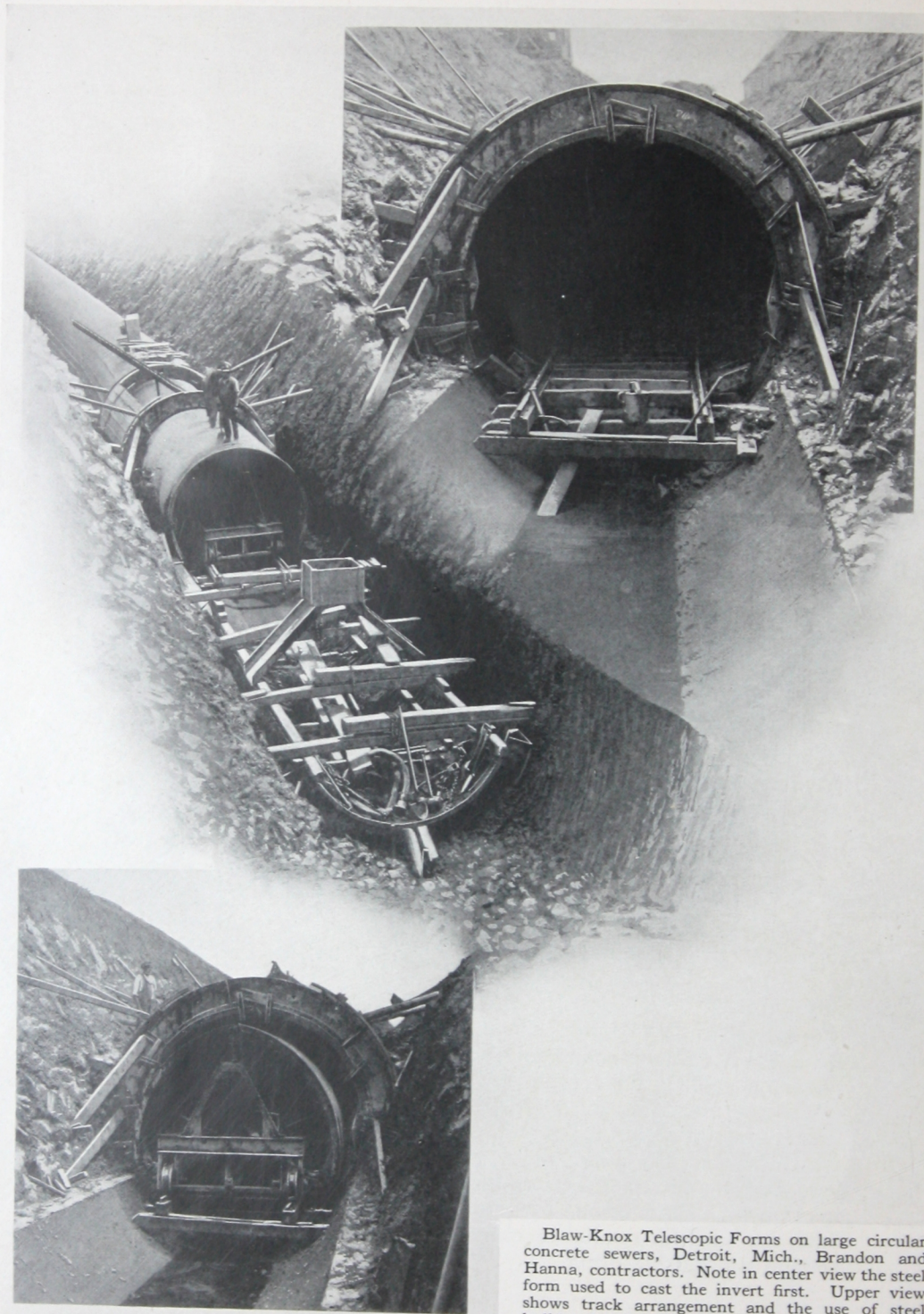
Assuming that 90 feet of form have been placed and concreted at a rate of 30 feet per day it is found at the end of the third day that the first 30-foot section can be collapsed, moved ahead on the traveler and concreted. In this manner a 30-foot section is poured every day. Sufficient invert is always concreted ahead for the movement of forms and traveler.

When the alternate block method is used, the form is designed along somewhat different lines from those of the telescopic form, as the traveler is attached permanently through the entire length of form and the form cannot be telescoped. Although this form itself is somewhat lighter in construction than the telescopic form, the traveler, being in this case an integral part of the form, provides the necessary additional strength required to carry the load.

Blawforms are made especially to conform with the particular requirements of the job in hand and once assembled need never be dismantled until the work is entirely finished. Particular attention is called to the mechanical action of the traveler illustrated on pages 8 and 10. This reduces the expense of moving forms to an absolute minimum. The items of repairs, leaks and maintenance which are considerable when wood forms are used are found to be negligible in connection with Blawforms. They also dispense with the need for special mechanical skill in setting up and handling.



*Blaw-Knox for General
Concrete Construction*



Blaw-Knox Telescopic Forms on large circular concrete sewers, Detroit, Mich., Brandon and Hanna, contractors. Note in center view the steel form used to cast the invert first. Upper view shows track arrangement and the use of steel bulkheads. Lower view shows form being moved forward on traveler.



*Blawforms for General
Concrete Construction*

Full-round Blawforms

IN many instances, conditions require the construction of a monolithic circular concrete conduit; that is, a conduit where the invert and crown must be placed at the same pouring. To meet this requirement both telescopic and non-telescopic Full-round Blawforms have been developed in sizes to conform with any specification.

One of the prime requisites of a telescopic Full-round Blawform is its ability to be speedily collapsed and then moved forward through forms which have been already concreted or forms in the process of concreting. Full-round Telescopic Blawforms meet these requirements.

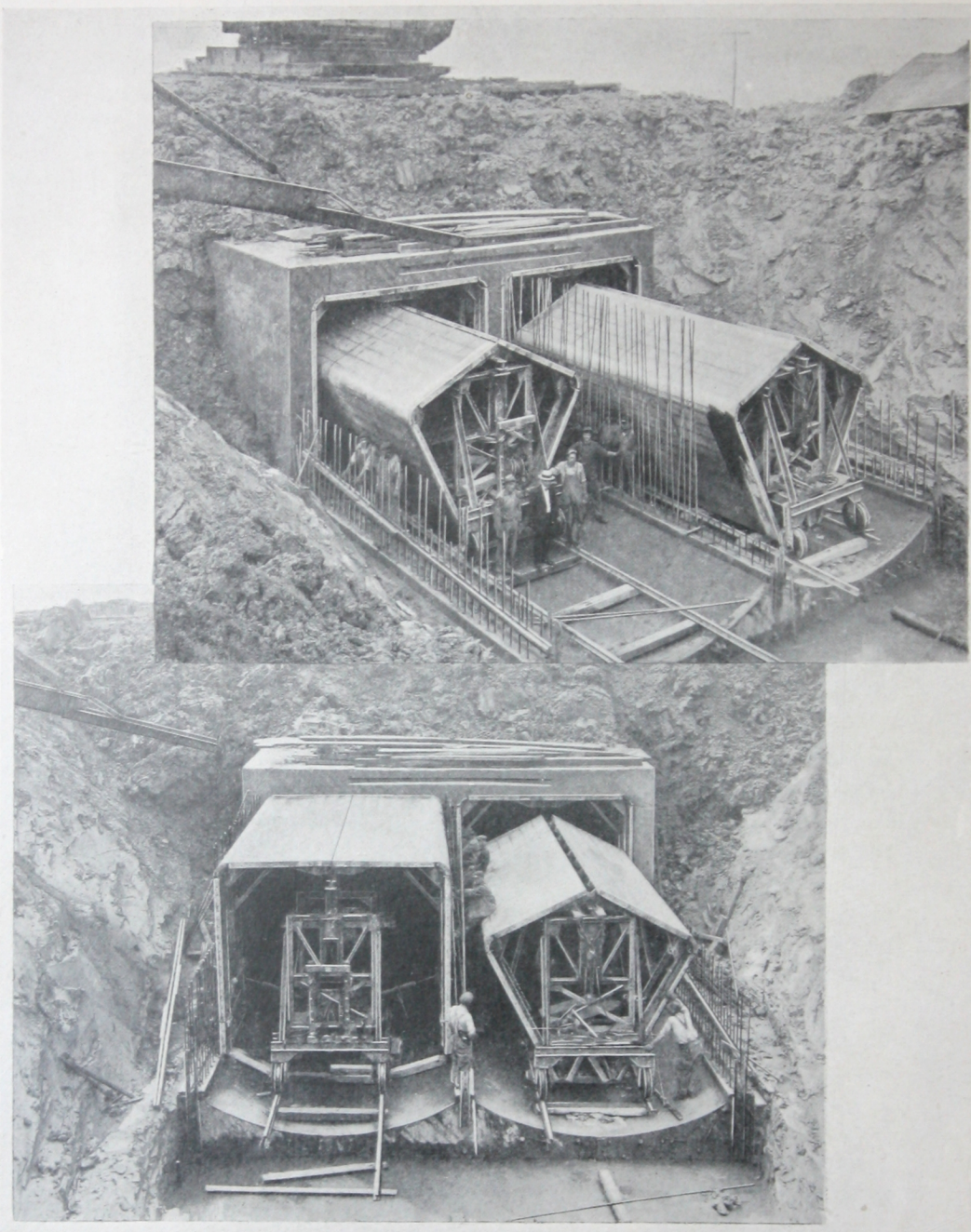
The forms are manufactured in sections 5 feet long and range in size from 36 inches to 144 inches in diameter. Each 5 foot section is made in four or more pieces, the joints being in a horizontal plane. At one of these horizontal joints a wedge-shaped piece is introduced in order to permit ready withdrawal of the form. All circumferential joints are staggered; that is, the horizontal joints do not line up on adjacent 5-foot sections.

This design of form is absolutely rigid and in perfect alignment at all times insuring finished work of perfect shape. The invert portion of the form has longitudinal angles riveted to the inside; and where the size of the form permits, a small car may be run on the tracks formed by these angles to carry the form from the rear to the front. All joints in these forms are bolted together with ordinary machine bolts.

After the forms have been erected and concreted and are ready to move ahead, the small car is run to the rear of the forms, a section of form is then collapsed, dismantled, loaded on the car and rolled to the front. The form is then re-erected in its new location and is ready for concreting. There is no interior bracing whatever in these forms, thus providing an unobstructed passageway for moving forms from one location to another.

There is also another type of Full-round Blawform which likewise is telescopic and is moved on a traveler in a similar manner to that illustrated on page 10.





Blawforms used in the construction of a large twin box sewer, Detroit, Mich., Walbridge and Aldinger, contractors. Each tube is approximately 14 feet x 14 feet. Note travelers and simplicity of arrangement for collapsing the forms, moving them forward and retaining them to line and grade ready for concreting.



*Blawforms for General
Concrete Construction*

Box Sewer Forms and Travelers

TRAVELING Rectangular Steel Blawforms are designed to conform with the conditions surrounding the construction of the box or rectangular sewer or conduit, the requirements for which are somewhat different from those mentioned in foregoing sections of this book. These forms range in size from 30 inches x 30 inches to 20 feet x 20 feet and larger when specified. Blawforms can be manufactured to meet every conceivable condition and contingency in connection with box conduit construction.

In many instances the conditions of flow are such that a given length of sewer may vary in size several times. Within certain limitations, a single set of Blawforms can be so designed that it can be used for varying sizes of conduit. The adjustments necessary to change the size of such forms are very simple and include the addition or removal of plates to or from the side wall or top of the form.

All Rectangular Blaw-Knox Forms are divided into two classes, the telescopic type and the rigid, non-telescopic type. Long experience has proved, however, that the non-telescopic form is cheaper to handle and it is therefore preferable where conditions will permit it to be used.

The illustrations on facing pages show in detail the application of rectangular Blawforms to sewer construction and it will be seen that the same size of conduit, constructed under varying conditions requires forms of different designs. Where permissible, however, the following standards are adhered to:

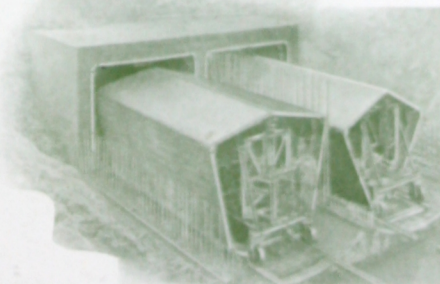
All sections are made 5 feet long.

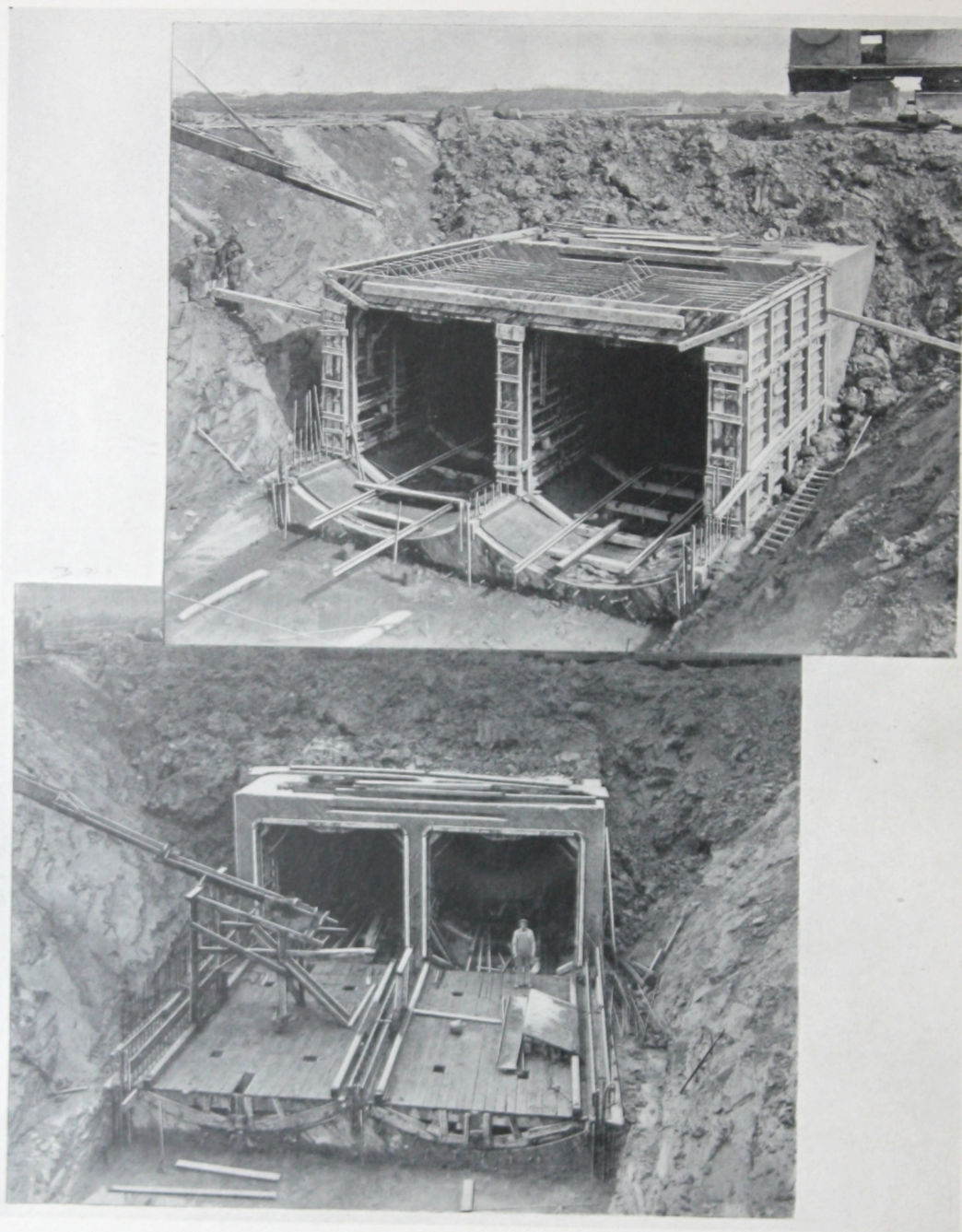
The plate placed next to the concrete is reinforced with angles or other means to provide proper strength and stability.

Non-telescopic forms are provided with travelers or wheels attached permanently to the form. Telescopic forms are provided with travelers of sufficient length to handle suitable form units but which are separate from the form.

Travelers are fitted with mechanical means for raising, lowering and collapsing the form.

All rivets next to concrete are countersunk so that a smooth and perfect finish is assured.





Blaw-Knox Forms used on large rectangular sewers showing the use of outside steel forms as well as inside steel forms. Traveler for inside forms is in rear getting a section ready to bring forward.
The outside form is handled by locomotive crane running on bank of trench.



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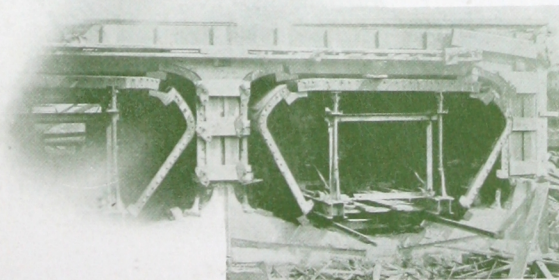
Each contract is carefully analyzed by our engineers in collaboration with the contractors or engineers responsible for the work. All details of construction conditions, speed required, etc., are considered and Blaw-Knox Forms are furnished in accordance with the results of the investigation. Thus all the engineering and study is performed *prior* to the manufacture of the forms so they are ready for instant use when delivered.

Blawforms are made to exactly fit the work. No makeshifts are necessary to adapt the work to the equipment which is so often the case where wood forms are used.

When Blawforms are used, a predetermined schedule of operation can be planned and carried through until the work is entirely completed.

Blaw-Knox Forms can be handled with great speed and can be removed in far less time after the concrete has been placed than is possible when wood forms are used.

All Blawforms provide a smooth, waterproof finish and require absolutely no repairs, maintenance or skilled operators to handle them.



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Blaw-Knox Single-track Railroad Tunnel Form used in construction of single-track railroad tunnel, Carolina, Clinchfield and Ohio R. R., Johnson City, Tenn., designed to permit constant passage of trains. Note there is no interior bracing to interfere with the traffic.



*Blawforms for General
Concrete Construction*

Blawforms for Railroad and Water Tunnels

AS tunnel work is from its very nature subject to local conditions and other varying factors, there are necessarily many different Blawforms for this class of work, each manufactured to conform with certain requirements. The forms can, however, be divided into four general classes, each class having characteristics peculiarly its own:

1. Railroad or railway tunnels.
2. Waterway tunnels of horseshoe shape.
3. Waterway tunnels of circular shape.
4. Tunnels of different shapes not otherwise classified.

Railroad and railway tunnels as a class are capable of subdivision as follows:

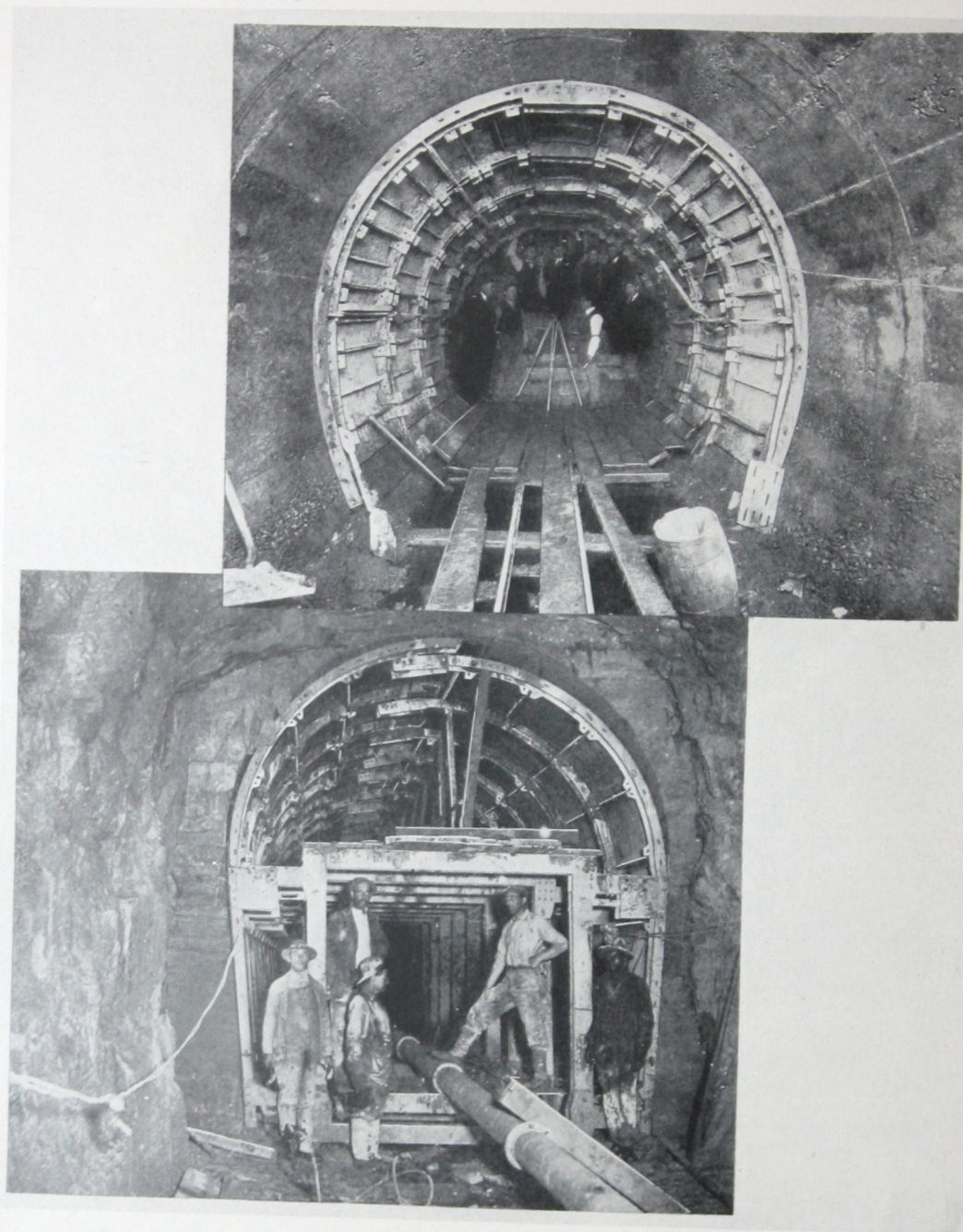
1. Tunnels concreted all around while traffic is maintained.
2. Tunnels concreted all around where it is not necessary to maintain traffic.

In the design and application of Blaw-Knox Tunnel Forms, every condition which is part of the work must be taken into consideration such as the number of trains per day, the clearance allowances, methods of placing concrete, speed of pouring and the length of time the forms must remain in the concrete before withdrawal.

While railroad engineers have as far as possible standardized the design of tunnels, yet in almost every case the construction and clearance requirements are such that it is necessary for our engineers to consult with the contractors before the proper form can be designed. A conference of this character results in the solution of all concreting problems before the job is begun and results in high speed and low costs. The services of Blaw-Knox engineers are always available either before or after the contract is let and we are always prepared to furnish complete designs and estimates to assist the bidders to ascertain their costs.

All Blaw-Knox Forms for railroad tunnels and for the horseshoe type of water tunnels are provided with a traveling device which is part of the form itself when the form is collapsible but non-telescopic.





Blaw-Knox Water Tunnel Forms. Upper illustration shows 10-foot tunnel form used in the city of Chicago by Nash Dowdle Construction Co., designed without bracing of any kind to permit passage of large muck trains. Lower illustration shows 14-foot tunnel form with bracing but sufficient clearance to meet working conditions, sold direct to the city of Chicago. Note how the removable lagging plates are attached.



*Blawforms for General
Concrete Construction*



Blaw-Knox Double-track Railroad Tunnel Forms used on the L. & N. R. R., by The Meachem Contracting Co., designed to permit traffic without interruption. This form has the traveler mounted integral with the side-wall sheets and arranged to provide the necessary clearance.



When the form is telescopic a separate traveler is used to handle the required unit of form. Blaw-Knox Tunnel Forms can be so designed that the same form can be used for varying degrees of curvature and for straight work in accordance with specifications.

Blawforms have been used in practically every tunnel job in the United States which has been let in the last few years. They are especially designed to suit the exact conditions present in each particular job. These forms may be made entirely of steel, of steel only up to the horizontal springline or of steel ribs with wood lagging. Particular attention is called to the fact that when steel forms are used the concrete may be placed either by compressed air or by hand.

In horseshoe-shaped water tunnels as in railroad tunnels, the conditions surrounding the construction absolutely determine the design of the form. These conditions may require a full-steel form with allowance in design to permit mucking cars to pass through the form, an all-steel telescopic form or a traveling side-wall form with a separate traveling crown form. When the concrete is placed from dump cars, an elevator or incline may be required as part of the form to enable the concrete dump car to obtain proper elevation.

Hundreds of feet of Blaw-Knox Tunnel Forms have been used on the Catskill Aqueduct and by the Cities of St. Louis, Chicago, Detroit, Pittsburgh and as a matter of fact all over the United States wherever tunnel work has been performed.

The fact that these forms are all-steel (except where otherwise specified), equipped with travelers and mechanical collapsing devices and are so designed that any number of feet of forms can be operated at one time, means that they save time, labor and material over any wood form that can be constructed.

Owing to the fact that circular water tunnels are built in sizes from 30 inches to 15 feet in diameter, it necessarily follows that the design of forms for this class of work will vary greatly. On circular tunnels of 6 feet and over it is usually arranged so that a traveling steel form can be utilized, thus enabling the tunnel contractor to

benefit from all the economies incidental to the use of such forms. The Blaw-Knox Company is prepared to supply forms for any size or shape of tunnel and will gladly submit plans and estimates upon request.





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In connection with the construction of very large concrete tunnels for water works or other uses, through materials such as soft rock, etc., it is quite often necessary to devise some method for supporting the roof during the progress of the work. Heretofore large timbers have been used for this purpose with more or less success. The Blaw-Knox Company, however, has designed and furnished for use on a large number of tunnel jobs, a system of steel roof supports which not only resulted in a saving of money but provided stronger and more satisfactory supports than was possible through the use of wood timbering.

In some instances where these steel roof supports were used, it would have been impossible to have handled the work in any other way. We are prepared to furnish designs and estimates covering the Blaw-Knox System of steel roof supports for any work where heavy timbering is ordinarily required.

In the lining of concrete tunnels for railroads it is frequently necessary to enlarge the bore of the tunnel or remove rock that is in the process of disintegration and to perform this work without interruption of traffic. We have designed and furnished, on several large railroad projects, a system of traveling steel shields which protect the traffic at all times and allows the work to go forward without interference with traffic schedules. We are prepared to submit upon request of engineers or contractors designs and estimates for these traveling steel shields.

Engineers and contractors are invited to submit their tunnel or shaft problems to our engineering department which will supply full and detailed information promptly, and which is at all times at the service of the customer.



*Blaw-Knox for General
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Blaw-Knox Pressed Steel Tunnel Liner Plates for supporting excavation and Blaw-Knox Special Half-round Collapsible Steel Forms used in the construction of a concrete sewer in Milwaukee, Wis., John F. Casey Co., contractors. Note how the tunnel liner plates line up and form a true circle.



*Blawforms for General
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Tunnel Liner Plates

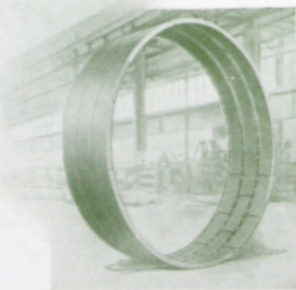
THE introduction of steel tunnel liner plates about eight years ago has resulted in their almost universal adoption for use in soft ground tunneling where support is needed to preserve the natural arch of the ground until the permanent lining can be placed.

Owing to their relatively low cost, uniformity of fabrication and the speed and ease with which they can be placed in soft ground headings, they have given the engineer and contractor a safe and economical method of tunneling in soft ground.

The use of Blaw-Knox Plates in ground of a loose character under city streets, with the application of the proper amount of compressed air when structure is below tide or ground water, has proved far superior to the shield method as there is practically no loss of ground due to voids outside the lining. They have taken the place of wood lagging, poling boards, wood segmental lining and the built-up plate and have proved not only less costly to manufacture but, owing to their flexibility, lend themselves to better progress in the work, resulting in a very appreciable saving of labor.

One of the most difficult phases of soft ground tunneling under city streets is the filling of the void left behind the tail of a shield. This difficulty is entirely eliminated when light plates are used as they are placed directly against the ground on the minimum net line, eliminating both the extra excavation which, in a large structure, amounts to a considerable yardage, and the placing of an excess amount of lining material outside the minimum net line.

Blaw-Knox Tunnel Liner Plates have been used in work involving almost all classes of material; namely, clay (both hard and soft), fine sand, coarse sand and gravel, and the results obtained have been eminently satisfactory.



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Blaw-Knox Special Steel Subway Forms used by Hickey Bros. in the construction of the Cincinnati Subway. Note the travelers setting up in front of the inside forms. On this work the outside form and the hoisting and distributing plant are integral and mounted on a traveler. Note sturdy construction used throughout.



*Blawforms for General
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Blawforms for Subways

STEEL Blawforms for subway construction are designed to meet the specific conditions inherent in each particular locality and to accord with the system of concreting adopted by the contractor in charge of the work. Blawforms can be equally well designed for any type of subway including the column and girder type as used in the construction of the New York Subways or the plain-wall and flat-roof type as adopted by the City of Cincinnati. Blawforms were used in both these constructions with undisputed success.

The fact that subways are designed of uniform cross section throughout their length, presents a type of construction admirably adapted to receive every possible economy from the use of Blawforms as a minimum number of sections can be used in the work to secure maximum results. The number of such sections used depends upon the number of feet of concrete required to be poured in a day, and the time required for the concrete to set sufficiently to warrant shifting a form to another section.

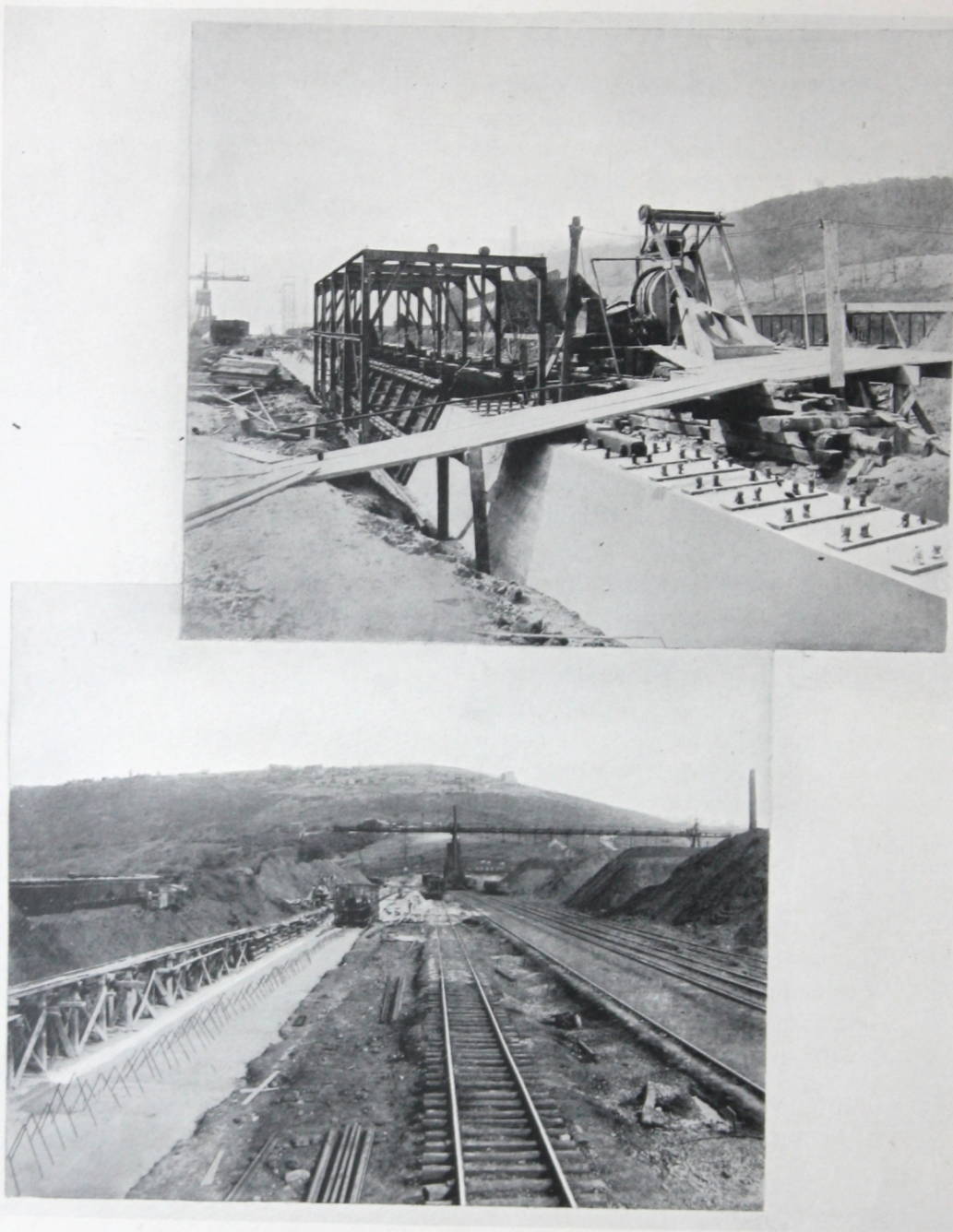
In subway construction, for obvious reasons, it is nearly always essential that as little of the street be opened at a time as possible. This mode of construction necessitates the use of a telescopic form which can be collapsed as soon as the concrete has set, and pulled through the green concrete to the next position. Blaw-Knox Telescopic Forms meet this condition admirably. They are collapsed by mechanical means and large units of side-wall and roof forms are readily moved in a single operation.

The forms are so constructed that all steel plates making up each section of form present a smooth finished surface to the concrete.

The Blaw-Knox Company invites designing engineers, who are interested in subway problems, to consult with their engineering staff, who will place at their service without obligation a wealth of experience and advice gained through intimate contact with subway construction in New York, Philadelphia and Cincinnati, where Blawforms successfully fulfilled all requirements.



*Blawforms for General
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Blaw-Knox Traveling Steel Wall Forms used in industrial plant work for ore or storage bin walls, sold direct to the Cambria Steel Company, Johnstown, Pa. This wall varied from 4 feet 6 inches to 10 feet 6 inches high and from 4 feet 6 inches to 6 feet 6 inches in thickness. Note the simplicity of the handling mechanism.



*Blawforms for General
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Blawforms for Heavy Walls

THE fact that Blaw-Knox Forms can be used repeatedly on section after section of a job, adapts these forms ideally to the construction of heavy concrete walls. Mounted upon travelers, Blawforms are moved with ease from one position to another permitting continuous re-use of the same forms. This results in a series of uniform units which constitute a smooth, straight and strong wall, built with the greatest possible speed and economy.

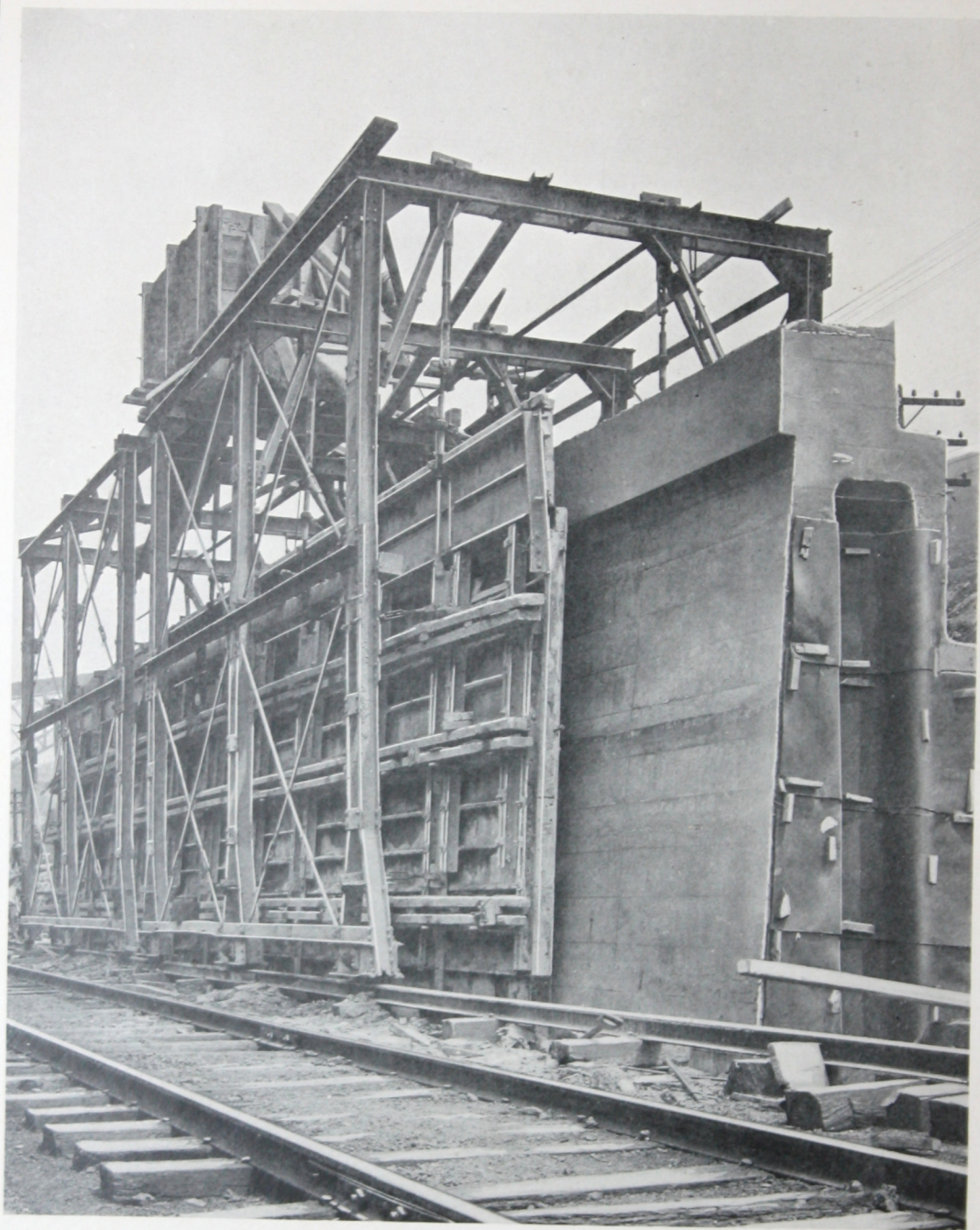
To the contractor estimating on a contract, Blawforms offer a distinct advantage. The first cost of the forms is fixed by contract and the cost of moving can be determined with accuracy, because being moved mechanically, the cost remains constant for each unit shifted. Given these two important items, the contractor is able to figure his costs with a degree of certainty possible only with the use of Blawforms. There is no element of speculation to consider and no wastage to take into account.

Wear and warping, repair and rebuilding of forms are unknown when Blawforms are used. The forms themselves are constructed of heavy steel panels, reinforced by steel angles. They can be used repeatedly without the slightest damage or loss. The last section of wall is formed as smoothly and evenly as the first section.

The travelers upon which Blaw-Knox Forms move are an integral part of the form plant. There are two types of traveling wall forms, the cantilever type and the gantry type. Each of these types can be used for forming plain walls or walls with buttresses.

When the wall is so situated that the track can be laid on only one side of the wall, the cantilever type of traveler is used. This consists of a structural steel frame mounted on a truck. The frames project up and over the wall in such a manner as to engage the forms by means of hangers and jacks. The forms are adjusted by these hangers and jacks to their proper elevation and alignment. Considerable latitude is possible in placing the track as ample adjustment is provided for in the jacks and hangers. With this type of traveler, the forms for both faces of the wall are handled at the same time, it being necessary only to extend the top brackets over far enough to

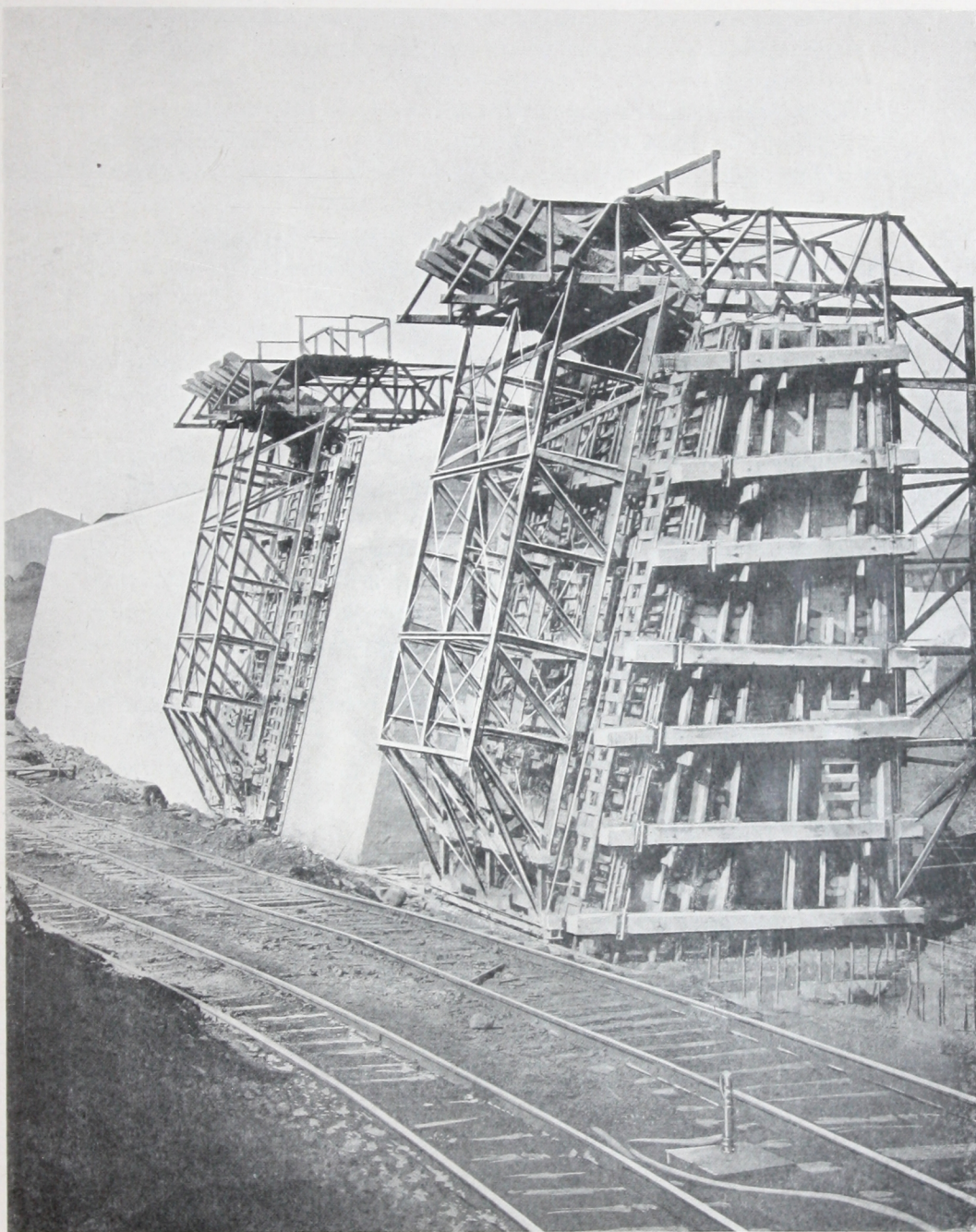




Blaw-Knox Gantry-type Traveling Wall Forms complete with coping, used in construction of retaining wall for the B. & O. R. R. Wall averaged 18 feet high and was designed with stepped back. Note use of walers and design of traveler.



*Blaw-Knox for General
Concrete Construction*



Blaw-Knox Gantry-type Traveling Wall Form used by Stone and Webster in the construction of retaining wall for the Brier Hill Steel Co., Youngstown, O. Average height of wall 37 feet. Note sturdy construction of form throughout.



hold the back forms. By carrying both the front and back forms in a single operation, the cost of moving the forms is reduced to the lowest possible figure.

Where it is possible to have the track on both sides of the wall, the gantry type of traveler is adopted. In this case only one rail on each side of the wall is required, as the structural steel frame of the traveler straddles the wall. The forms for both faces of the wall are attached by hangers and jacks to these frames. Whether the back face of the wall is stepped or battered, these forms can be used with efficiency and economy.

When walls with buttresses are to be constructed, a collapsing apparatus is provided which will collapse the box-shaped form and swing it out beyond the buttress from which position the form is moved ahead in a unit.

Blaw-Knox Heavy Wall Forms are so designed that few, if any, tie rods are required. This feature insures maximum economy in the construction of retaining walls, track elevations, dry dock walls and other structures which have great thickness at the base. In the gantry type of form the standard trusses are designed of sufficient strength to take the pressure of the concrete so that only one row of tie rods is needed near the base for the purpose of tying the trusses together. This eliminates all tie rods otherwise needed for holding the forms together. The placing of tie rods is objectionable due to their cost and to the fact that wherever they are used they deface the wall leaving openings which have to be filled in or plastered afterwards.

The concrete pressure is distributed from the plates to the reinforcing angles, then to the walers and from there to the trusses of the traveler. For special forms where tie rods are a necessity, the walers act not only as liners for the forms but also take the reaction from the ties. The walers extend the full length of each unit, are attached securely to the forms and furnish a means of connecting the bulkheads in such manner that these can either be hinged and swung open to allow the removal of the forms or moved with the forms to a new position, being carried on the travelers together with the forms.

Often it is possible to obtain ample bracing at the foot of the wall for taking the pressures, in which case all tie rods can be eliminated and the reactions taken by the traveler. This





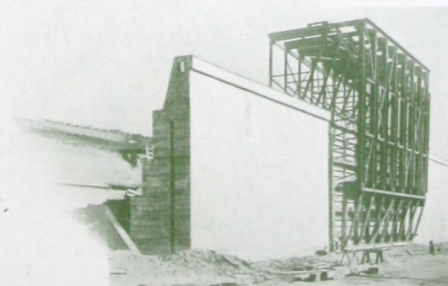
*Blawforms for General
Concrete Construction*

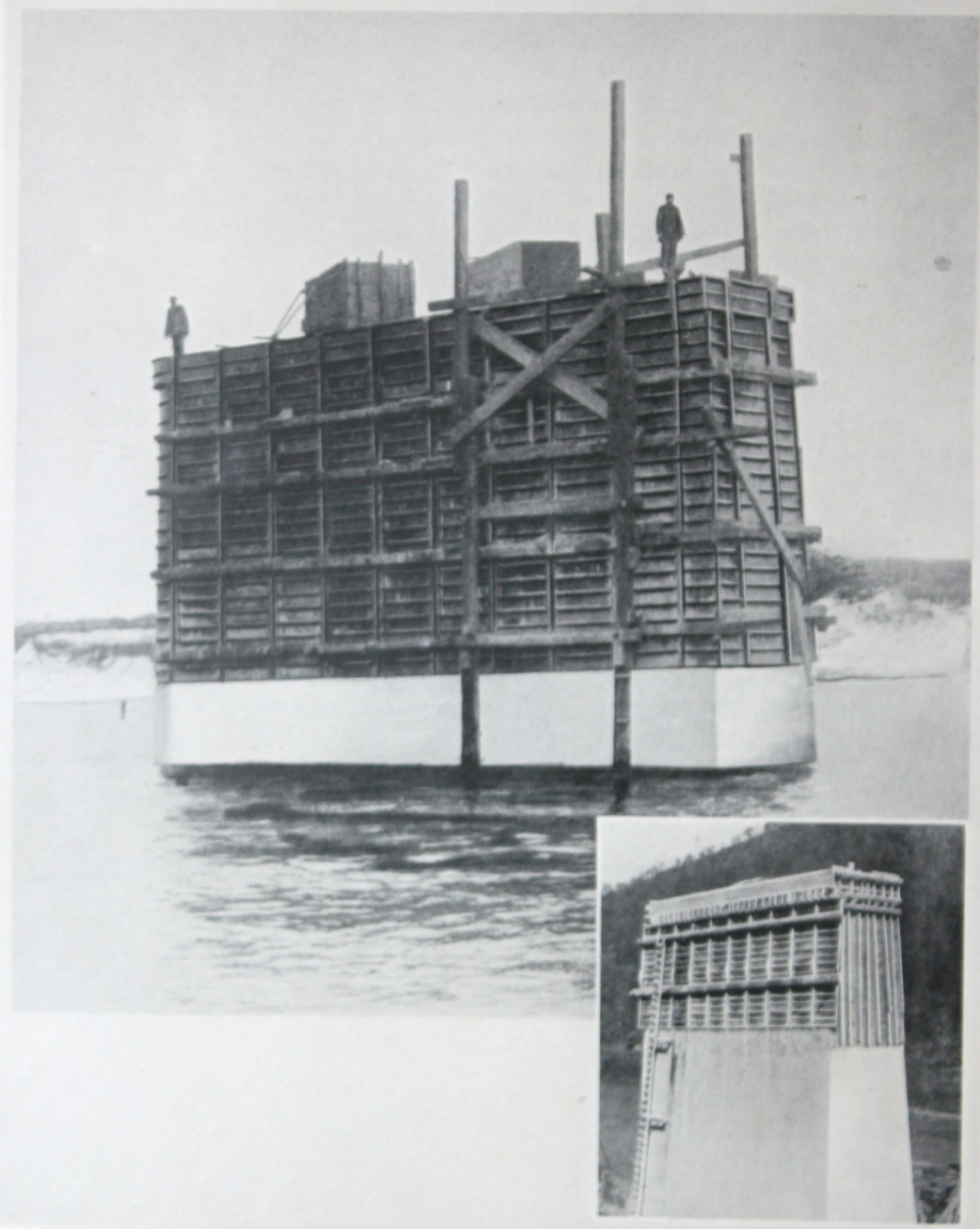
necessitates a heavy traveler, well trussed and braced and augmented by a system of wedges and jacks inserted between the walers and the traveler frames. The wedges are easily removed.

The traveling wall forms described in the foregoing paragraphs are collapsible but not telescopic. They all have the traveler which carries the form when moving and supports the form while concreting. Under certain conditions such as the construction of a sea wall, where it is necessary to place the walls very quickly after the foundation is laid, telescopic, traveling Blawforms are furnished. These forms are constructed to take the entire concrete pressure without the assistance of the traveler, being held together by tie rods placed through the forms themselves or through trusses built together with the form as one unit. Sufficient clearance is provided to allow the traveler to pass by the forms in place, thus making it possible to use as many units of forms as are required for the progress desired.

In heavy wall work, as in all other constructions where Blaw-Knox Forms are used, the problem is studied from every angle by experienced engineers and a form designed which will accomplish the desired result with a minimum of expense.

A special type of Blaw-Knox Wall Form has been developed for subaqueous work. The form is supported on an adjustable framework of the straddle or gantry type. This frame has adjustable legs to conform with varying depths. The form is collapsible and operated from above the water level, the services of a diver being required only to remove the bottom tie rod. This form is designed to eliminate the coffer dam which is customarily used in such construction and thus greatly reduces the expense of subaqueous concrete work.





Blaw-Knox Pier Forms made up of Blaw-Knox Combination Lagging. Note the extreme simplicity of design and application.



*Blawforms for General
Concrete Construction*

Blawforms for Piers

CONCRETE piers for bridges are subject to much greater variation in design than the majority of concrete structures. Each contract requires individual study resulting in a special form being designed to meet the requirements.

There are, however, certain parts of the work in connection with which standard forms can be utilized. The use of these standard forms is followed as far as possible to reduce the cost of the form work to an absolute minimum.

The standard form used in connection with pier work is Blaw-Knox Combination Lagging. This consists of heavy plates 12 inches wide by 60 inches long, reinforced on all edges by heavy angles. Vertical channels or angle liners and horizontal channels or wood walers are used to line up the plates which are so arranged that they can be fastened together permanently to form units of any size required.

If derricks are available, the forms can be handled in as large panels as the capacity of the derrick will permit, the forms being fastened together as explained in the foregoing paragraph. The forms can also be handled by hand or with hoists in units of varying size.

Special forms are always manufactured for the nose or ends of the piers, as requirements vary so greatly that it is impracticable to design standard forms for this part of the work.

There are decided advantages in the use of Blawforms on concrete pier work:

- Units of Blawforms will not warp.

- The number of tie rods is greatly reduced.

- The forms need no repairs.

- There are no adjustments to be made as the forms are designed for the job.

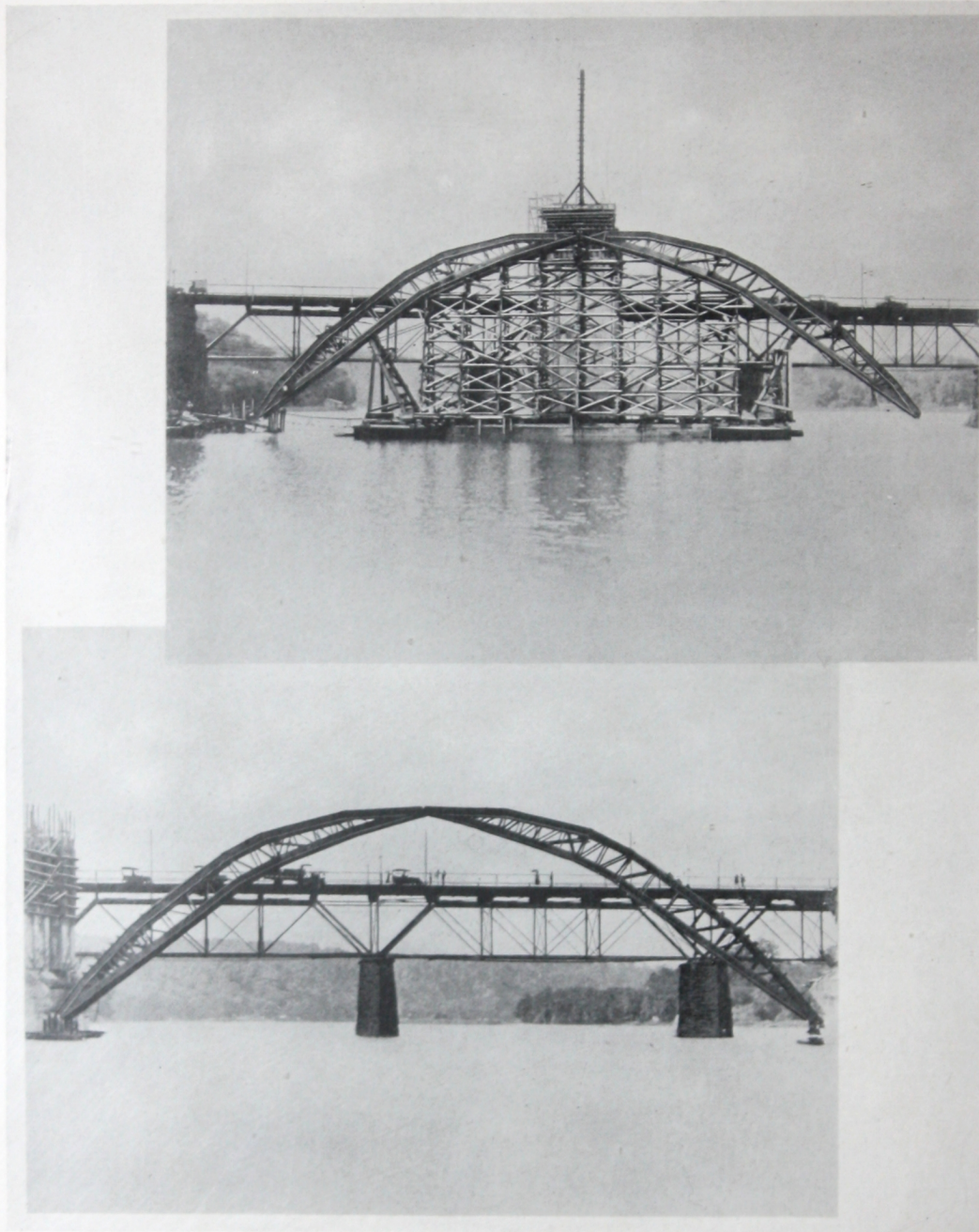
- The work will be completed in the shortest possible time with less labor expense.

- A high-grade finished job is assured.

Engineers and contractors are invited to submit their plans for pier work to our engineering department, which will, without obligation, outline the most economical methods for forming the work.



*Blaw-Knox for General
Concrete Construction*



Blaw-Knox Steel Centers for Concrete Bridges. One of the largest and most difficult applications of steel centers, sold direct to the U. S. Government for the Key Bridge, Washington, D. C. Note the false work with rib floating into place in upper illustration and in the lower illustration the false work floated from under the rib and the rib ready for the wood form work.



*Blawforms for General
Concrete Construction*

Blawforms for Concrete Bridges

AMONG the many conditions surrounding the construction of concrete bridges, there are found many controlling factors which necessitate a departure from wood centering and the adoption of a centering method that will not retard the progress of the work and at the same time afford the ultimate economy in construction.

Among the principal conditions which feature the adoption and design of centering are: Clearances under the centers for the maintenance of traffic; the necessity of adopting proper centering to eliminate possibility of washouts where bridges cross rivers having great velocities under flood conditions; the adoption of centering which makes it possible to obtain a definite support on the concrete piers where otherwise supports would have to be obtained by piling in the bed of the stream, which under some conditions would be neither practical nor possible. Blaw-Knox Steel Centers not only minimize the difficulties attached to all the above conditions but actually simplify the construction of the bridge itself and are also an insurance against fire.

In designing steel centers, the Blaw-Knox Company has adopted certain standards which have been found of great value in meeting in a practical manner such conditions as ordinarily prevail in bridge work.

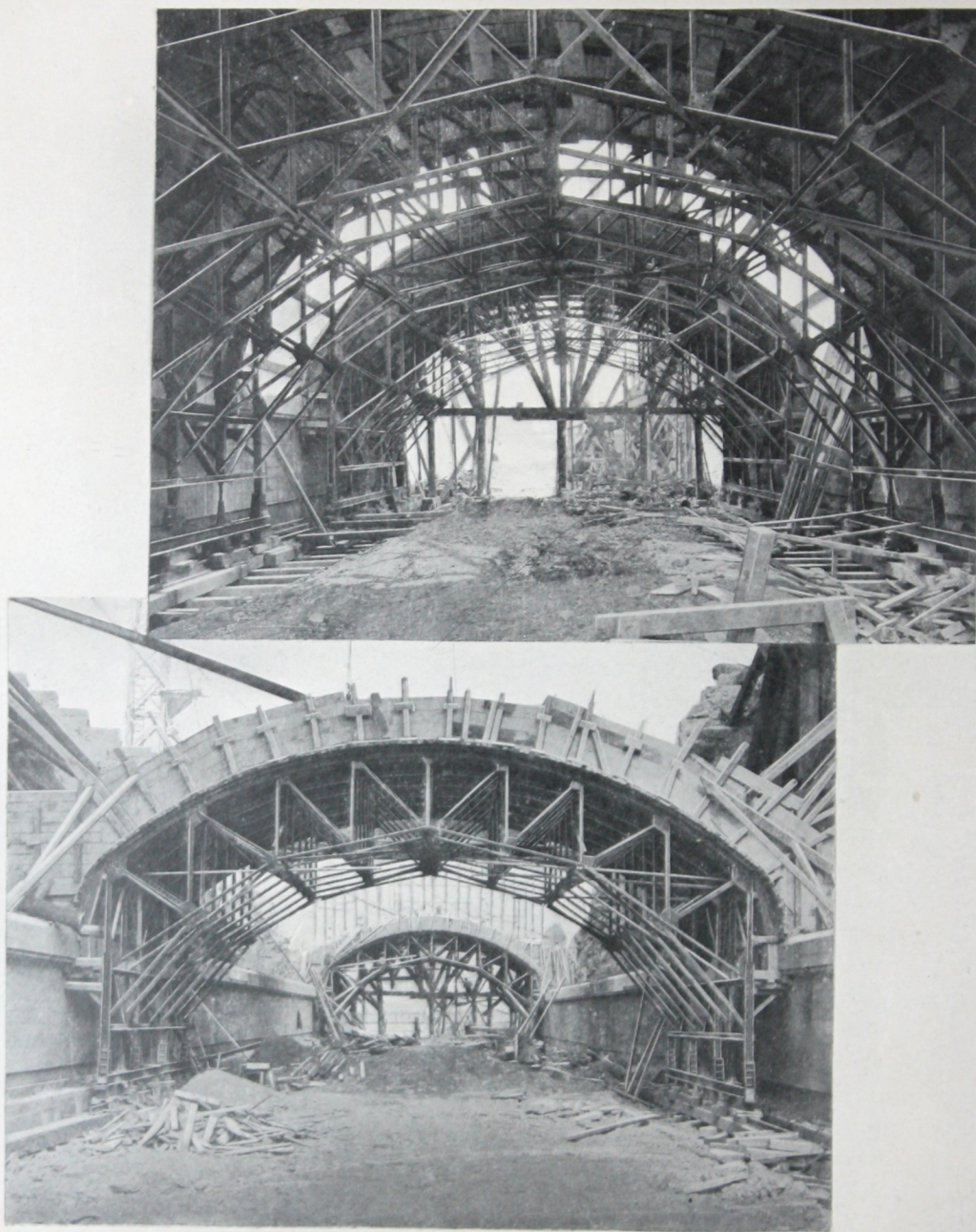
In the first place, each member in a steel center is subjected to certain stresses which vary in accordance with the spans, thickness of arch and the method of placing the concrete—whether it is placed from the haunches towards the crown in one continuous operation or whether it is placed in blocks.

It is a comparatively simple matter to design a center which will take care of arches of the same dimensions, but as it becomes necessary and desirable in the concrete bridge to use different spans and different dimensions, the steel center in order to be practical, should be made adjustable so that it can be used for arches of varying size.

During the past ten years, the Blaw-Knox Company has made a special study



*Blawforms for General
Concrete Construction*



Showing special application of Blaw-Knox Traveling Steel Centers used by M. O'Herron & Son in construction of Corliss Street Tunnel, Pittsburgh, Pa. Note the lack of debris and the simplicity of the arrangement.

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*Blawforms for General
Concrete Construction*

of the problem involved and has perfected a steel center which has sufficient strength and adjustability for use in connection with arches of varying dimensions. This center is made of units which can be assembled in the field without field riveting. It will meet conditions of construction in such a manner that no undue stresses are placed on the piers either during construction or when centering is removed.

The method of designing Blaw-Knox Steel Centering takes into consideration the erection and handling during construction and the removal of the centering after the work is completed, all of which can be done with the use of ordinary equipment which is common to a contractor's plant. On bridges consisting of many spans, where there are many arches to be made by these centers, special apparatus is designed to facilitate the operation of the centering, such as travelers supported on trestle work or floating carriers which can handle a completely assembled center and move it from one place to another.

In connection with the centering of main carrying members for the bridges such as concrete arches, concrete girders etc., it is desirable on long bridges where the rise is considerable to provide means for supporting the forms for the bridge deck. This is accomplished by Blaw-Knox Traveling Deck Forms. These forms consist of box forms, arch forms and flat-slab forms, depending upon the type of deck to be constructed, in connection with cross trusses which support the bottom of the concrete beams and intermediate slab forms in such a manner that the slab forms can be removed quickly as soon as the concrete has set sufficiently between the cross girders. The trusses underneath the cross girders are left until the structure is in condition to carry itself and are then removed and reset by means of the travelers.

The removal of the deck forms and the cross trusses is accomplished by means of travelers which run on tracks supported on brackets fastened to the concrete arches or girders.

In connection with the above forms, Blaw-Knox Steel Forms are designed for columns, railing and curbing insuring increased speed in the performance of the work and a smooth even finish of the concrete.



*Blawforms for General
Concrete Construction*



Blaw-Knox Telescopic Groined Arch Forms and Traveler used in construction of St. Paul Reservoir, St. Paul, Minn. George J. Grant Construction Co., contractors.



*Blawforms for General
Concrete Construction*

Traveling Floor Forms

THE expansion of large industries, railroads and harbors necessitated by present and prospective developments of business and traffic is exhibiting itself more and more in the demand for buildings, stations and piers with very large floor space and frequently several floors all practically identical. Designers are realizing that by standardization, or making the floors identical, an immense saving can be made, not only in material, but also in the time necessary for construction. This saving is due principally to the improved methods of construction which can be followed when Blaw-Knox Traveling Floor Forms are used, as they not only reduce the cost of construction but insure a materially better building. The following paragraphs briefly describe the methods of construction generally followed in connection with the use of Blaw-Knox Traveling Floor Forms and will convey some idea of the economies resulting from the use of this system.

The floor molds are supported on timber posts placed in such a manner that sufficient clearance is left between the timber posts for collapsing and telescoping one bay of floor molds with the steel column head attached.

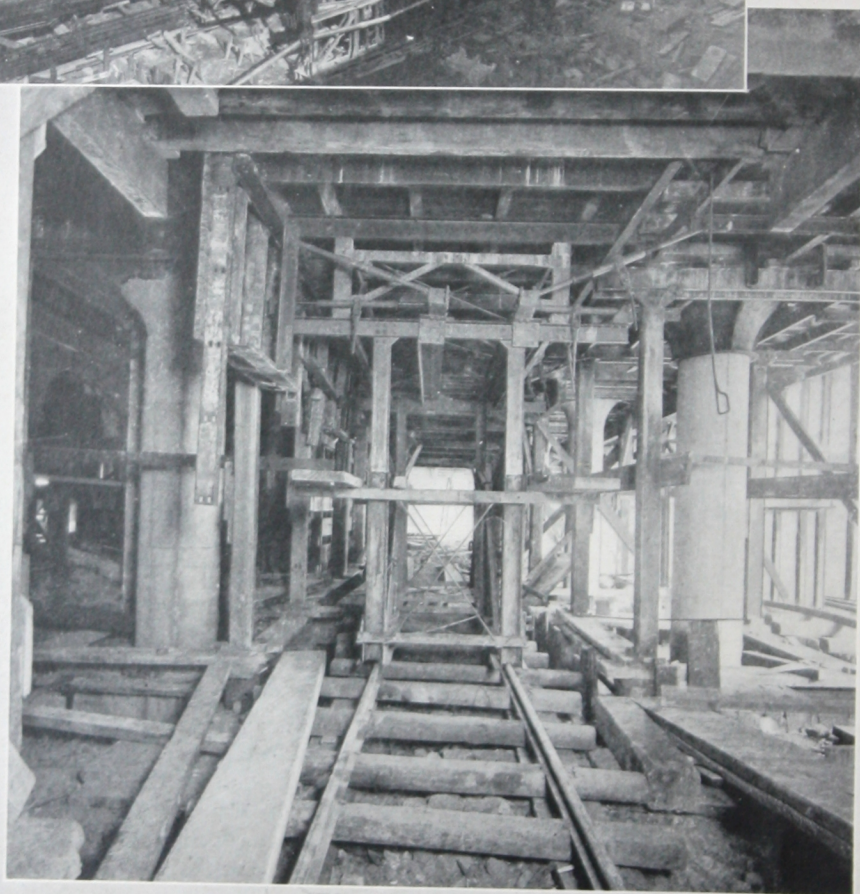
The column shanks are removed and handled by hand; the rest of the form is handled on a traveler.

Generally if there are four sets of forms with one row crossways, there are as many travelers needed as there are rows of forms. This is clearly indicated on illustration shown on facing page which illustrates a series of tracks running under each row of forms.

Comparing this method with the usual procedure of constructing either flat-slab floors or beam and girder floors where the forms are handled by hand in smaller units, it is evident that wherever the design is such that a large number of units are similar or where it is possible to run for a certain length without changing from one elevation to another, it is cheaper and better to use travelers on the work.

The detailed design of travelers and forms depends on the type of floor and the conditions under which the work is to be carried on. Where a great variation is to be overcome in the height from the floor to the ceiling or from the ground to the first floor, the travelers are

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Concrete Construction*



Blaw-Knox Traveling Floor Forms used by Morris, Shepherd Dougherty and Grant Construction Co., in the construction of the Union Station, St. Paul, Minn.



so made as to allow as much as 8 to 10 feet of variation. Generally travelers allowing a few feet variation will take care of conditions ordinarily encountered but whatever variations are present in the work, can be compensated for in the design of the form. This also applies to the different spans of the bays between columns. These generally average 20 feet, for which spacing the form has been standardized; however, variations from 18 to 24 feet between columns are easily taken care of.

Aside from the saving obtained by substituting large machine-handled panels for small manually-handled panels, there are other benefits to be derived from the use of traveling forms for this class of work. Due to the fact that the forms are built up and set together in large units, the numerous small joints present in the smaller forms are eliminated, resulting in a more nearly uniform and natural finish of the concrete thus eliminating any necessity for refinishing.

This type of form enables a fixed construction schedule to be predetermined and followed.

The illustration on page 40 shows a special type of traveling forms for groined arches. The forms are worked in a similar manner to that explained in preceding paragraphs. The forms are supported on wood posts spaced longitudinally between the precast columns, leaving sufficient room for the form to telescope through when collapsed. A traveler is required for each row of forms.

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The upper illustration shows the use of Blaw-Knox Traveling Steel Forms on drainage canal work. The lower illustration shows application of steel arch ribs over river.



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Blawforms for Miscellaneous Construction

THERE is an extensive variety of concrete work which requires absolute accuracy and smoothness of finish to meet specifications and which is also of such nature that the forms used in construction are subject to repeated use. For all such work Blawforms are incomparable. Each re-use of these forms increases their economy and only steel forms can produce the fine quality of work desired. It is useless to attempt to list the infinite variety of work to which Blawforms can be adapted but a few examples of such work are mentioned in succeeding paragraphs which will serve to illustrate the wide field of usefulness of this product:

Shaft Forms—Blawforms for shafts used in connection with mining operations are made in different types to conform with the prevailing conditions and dimensions of the shaft. They are generally constructed in collapsible units which can be handled in lifts the height of which is determined by the equipment available for lifting. Provisions are made in the form to avoid interference with bracing wherever such is necessary.

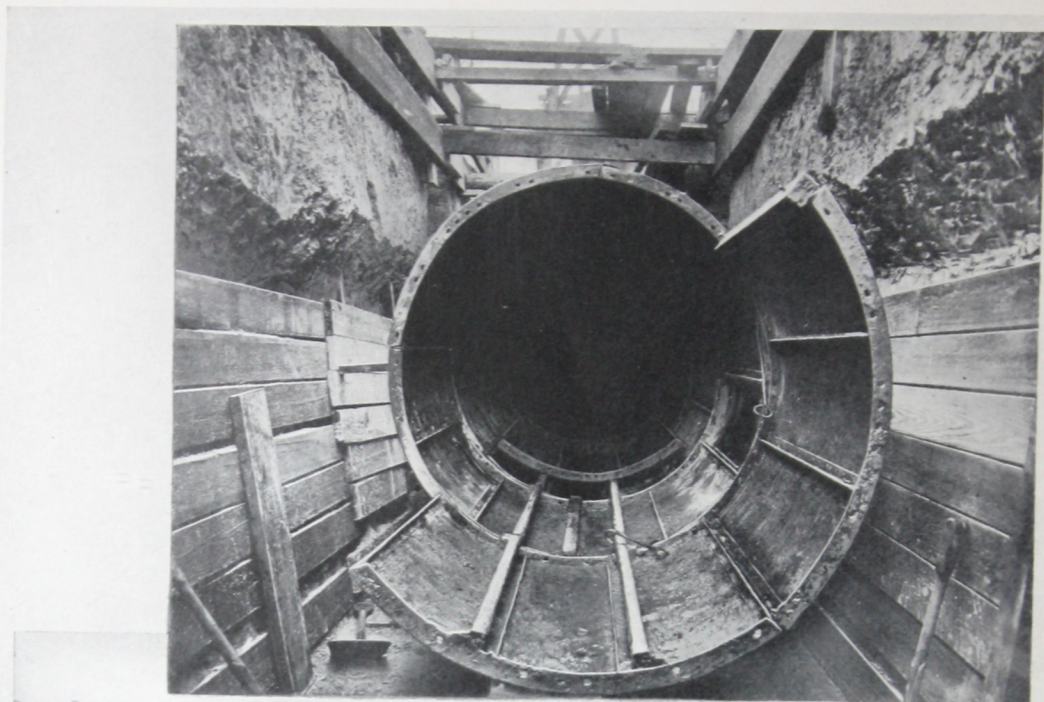
Draft Tubes—The construction of draft tubes is more exacting than any other class of concrete work. A draft tube must be true to calculated cross section and its finished face as much like a polished surface as possible. Blawforms are especially recommended for this class of work. Not only do these forms assure the desired smoothness but they will accomplish the result without waste and with a decided saving in time and labor.

Water Tower and Storage Tanks, Reservoirs and Sewage Disposal Plants—On contracts of this nature Blawforms have been a veritable boon to contractors effecting great reductions in costs as compared with wood forms.

Blawforms have been used with the same excellent results in the manufacture of precast concrete pipe, hand rails for bridges, concrete telephone poles and other work of similar character. In all duplicate work which must be true to design, steel forms alone will assure correct results.

Construction of irrigation ditches or the improvement of waterways by





The upper illustration shows Blaw-Knox Telescopic Full-round Form. Note the placing of sections and the track in invert. Lower illustration shows application of traveling steel forms to subway construction.



*Blawforms for General
Concrete Construction*

protecting the sides and bottom with concrete, call for the strongest and most efficient form which can be made. Blawforms have been used with signal success on contracts of this nature, being sturdily built, capable of adjustment over a wide range and arranged for mechanical handling.

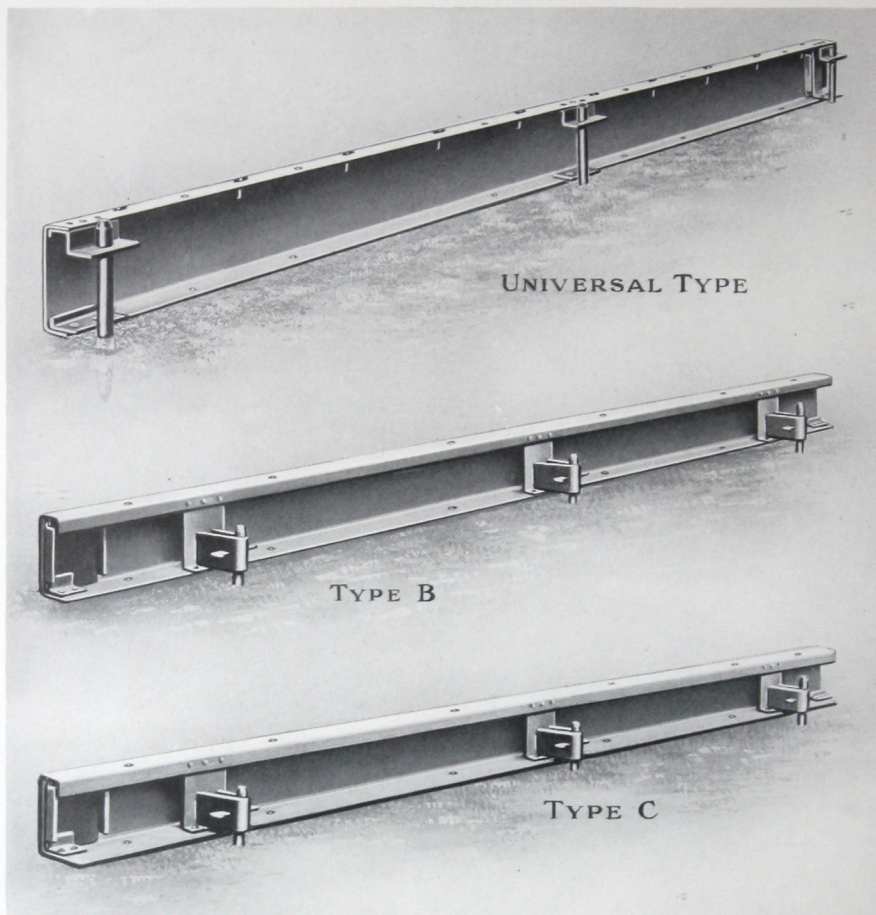
Blawforms have been found most economical for making precast culverts, septic tanks, special concrete blocks for dams, concrete piles, hollow piers for viaducts, fence posts and hundreds of other special uses.

The adaptability of Blawforms is also demonstrated when it is found necessary to build a retaining wall in close quarters; as for instance, paralleling railroad tracks. Blawforms and travelers can be designed to span the tracks and allow a freeway for traffic while the forms are being used.

There is a Blawform for every type of concrete construction regardless of its nature. There is no work so difficult, so inaccessible or so accurate that it cannot be successfully consummated through the use of Blaw-Knox Steel Forms.



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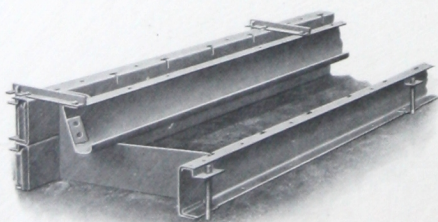


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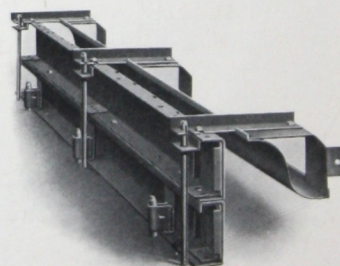
TYPE B

TYPE C

Ten-foot sections of the Three Types of Blawforms for Roads and Streets



Part of a 10-foot section of 6-inch Blaw Universal Form, with Blaw Steel Face Form, set up for combined concrete curb and gutter.



Ten-foot section of Blawform for building integral, curb and pavement.



*Blawforms for General
Concrete Construction*

Blawforms for Roads and Streets

WITH Steel Blawforms it is possible to construct curb, curb and gutter, sidewalks, integral curb and pavement and roads having a concrete base, far more cheaply and with better results than by any other method. These forms eliminate the necessity for skilled labor, increase the speed of the work and form permanent plant for the contractor, as they are proof against ordinary usage and will last for years.

There are three types of Blawforms for road and street construction—The Universal Type Forms, Type "B" Special Road Forms and Type "C" Special Road Forms. Each of these forms is universal in application as it can be used on all kinds of road and street construction. All types are interchangeable and can be used together without the use of auxiliary appliances.

Universal Forms are peculiarly fitted to the needs of the contractor who desires equipment that can be adapted for every variety of street work and for monolithic and cushioned brick roads, bituminous and asphalt surfaced roads on concrete base.

Type "B" Special Road Forms are recommended for the construction of hand, roller or belt-finished concrete roads.

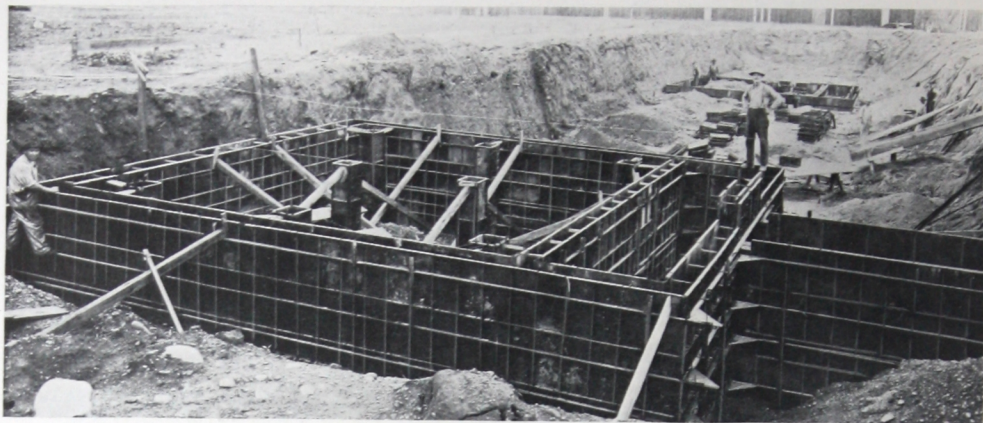
Type "C" Special Road Forms are extra heavy forms which are a necessity on roads where subgrading or finishing operations are accomplished mechanically.

The Blaw slip-joint connection and the Blaw method of staking provide forms which when locked together and staked are an integral and immovable unit but which can be handled at will with the greatest ease and with the least possible expenditure of labor.

Combinations of Blawforms can be made to construct any style of integral curb and gutter or sidewalk, to accomplish this at a cost far below other methods of construction, and at the same time produce a finished job of the highest possible order. Complete and detailed information on the subject of Blawforms for Roads and Streets is presented in a catalog devoted to the subject, a copy of which will be mailed upon request.

The Road Form Department of the Blaw-Knox Company is placed at the service of the contractor to aid him plan his entire job in such a manner that all costs can be anticipated, and profitable and commendable work accomplished. This service is entirely free from obligation.

*Blaw-Knox for General
Concrete Construction*

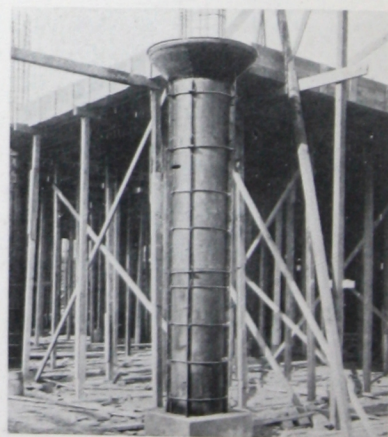


Blaw-Knox Light-Wall Forms give equally good results on foundation walls, retaining walls, and superstructure walls.



Blaw-Knox Steel Forms used in flat-slab construction. Forms set up ready to place reinforcing steel.

Blaw-Knox
Steel Column
Mould





*Blawforms for General
Concrete Construction*

Light-Wall and Building Forms

BLAW-KNOX Forms for Light Walls and Foundations are equally well adapted to large or small jobs. Their range of usefulness is extremely varied and they are especially suited to the construction of light retaining walls, foundations for houses and large buildings and superstructures. They will greatly increase the economy of concrete construction in connection with grain elevators, coaling stations, sewage disposal plants, baffle walls in reservoirs, side walls of circular tanks and any number of special classes and types of concrete work.

Blawforms are built entirely of steel and consist of a number of steel plate panels, each 2 feet square, reinforced with steel angles on all four sides and through the center. These panels are connected and held in positive alignment by means of liners, keys and ties. Fractional panels, lap panels and corner panels are used for adjusting the form to the proper length between corners, and to provide for various wall thicknesses.

Blaw-Knox service is a part of every job on which Blawforms are used and every possible advantage is reaped by the contractor whose equipment is planned and laid out by Blaw-Knox engineers. Complete details in regard to Blawforms for Light Walls will be found in a separate catalog devoted exclusively to the subject, which will be sent upon request.

The Blaw-Knox System for floor, roof and column construction owes it great economies in labor and materials to the fact that it is not merely a scheme for replacing wood forms with those of steel but that this system rotates labor, specializes operations and does not require special labor in the majority of its operations. It saves materials and labor for the contractor in nearly every phase of concreting from shoring to salvaging lumber. The forms themselves are simple in character and sufficiently strong to support extreme loads. Blawforms for beam and joist, flat-slab, rib-slab and relieved slab construction, meet requirements for every type of floor and roof construction. Space will not permit further description of the Blaw-Knox System for Building Construction but a copy of our complete catalog on the subject will be mailed upon request.



Products of the Blaw-Knox Company

BLAW-KNOX SECTIONAL STEEL BUILDINGS

Portable (permanent) buildings for light manufacturing, storage, field work and for housing men, materials and equipment. Blaw-Knox Steel Buildings meet practically every industrial plant requirement. Fire and weatherproof. Made in standard widths from 16 feet to 60 feet. Carried in stock. "Quixet" all-steel garages, single, double and multiplex.

BUCKETS (Clamshell)

There's a Blaw Bucket for every purpose: Single Line, Two Line, Three Line or Four Line for every class of service from lightest rapid rehandling to hardest digging and dredging.

STEEL (Fabricated)

Bridges, buildings, crane runways, manufacturing plants, mill buildings, steel poles, trusses and all manner of construction requiring fabricated steel.

PLATE WORK

Welded Construction—Forge and hammer welded containers for high pressures and extremes in expansion and contraction.

Oxy-acetylene or electric welded steel plate construction to replace troublesome castings and riveted work which cannot be kept water-tight.

Riveted Construction—Steel plate products of every description including accumulators, agitators, containers, filters, flumes, gear guards, kettles, standpipes, miscellaneous tanks, miscellaneous blast furnace work, etc.

FURNACE APPLIANCES (Patented)

Open Hearth, Glass and Copper Furnaces—Knox patented water-cooled doors, door frames, front and back-wall coolers, buckstays, ports, reversing valves, etc. The McKune System for burning fuel. The Mowry Dolomite Gun. Sheldon Mechanical Gas Producers.

Sheet and Tin Mills—Water-cooled floors and shields, water boshes, palm oil plants, annealing boxes and carriers, sheet bar carriers, sheet pack carriers, cut bar carriers, scrap buckets, acid tanks, grease pots, galvanizing kettles, cooling tables, terne pots. Annealing pots and covers for wire strip mills.

TRANSMISSION TOWERS

Steel towers for high-tension transmission lines. Four-legged straight line or suspension towers, anchor and dead-end towers, latticed and channel A-frames, river-crossing towers, outdoor substations, switching stations, signal towers, steel poles, derrick towers.

FORMS (Steel)

For every type of concrete construction. Columns, factories, fences, foundations, houses, reservoirs, roads, streets and sidewalks, sewer tanks, tunnels, walls, warehouses, etc.

SERVICE

Blaw-Knox Service is a part of every Blaw-Knox product. The engineering skill and experience brought to bear upon individual problems insure the adaptation of every Blaw-Knox product to meet the specific need of the customer.

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